NOTES ON THE LIFE HISTORY OF THE STYLOPIDÆ.

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During the past summer I had the opportunity of making a number of incidental observations on the two Texan species of *Xenos*, and of discovering the female of one of them, which has not hitherto been described. As these notes throw some light on the life history of these interesting creatures, I venture to present them at this time.

On May 22, at Paris, Tex., I captured a large overwintered female of *Polistes rubiginosus* which had evidently just left its hibernation quarters. Examination showed that it harbored a single female specimen of *Xenos nigrescens* Brues. The head of the parasite protruded between two of the apical abdominal segments and a number of triungulins were emerging from the small rectangular orifice on the anterior portion of the exposed surface of the head. The triungulins do not move very rapidly and cling rather tenaciously to the body of the wasp, even when the latter is shaken violently about. They keep continually in motion, however, and when the wasp is resting a number of them are always crawling off upon adjacent objects. They are rather dark brown in color and scarcely visible to the naked eye. The following description is drawn up from a number of mounted specimens:

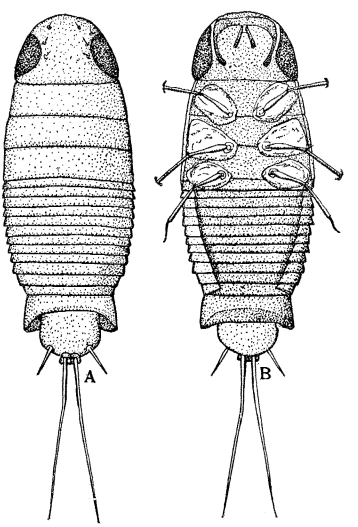

FIG. 1. Triungulins of *Xenos nigrescens* Brues. *a*, dorsal view; *b*, ventral view.

Length .28 mm. Oval, head obtusely rounded anteriorly. Head and thorax together slightly longer than the abdomen. Head a little less than half as long as the thorax, almost semicircular when seen from above, being

truncate behind. Eyes large, strongly pigmented. Oral opening large, almost contiguous with the eyes below; mouth parts consisting apparently of a short proboscis-like organ with chitinous sides. No antennæ or other tactile organs to be seen. Thorax one and one-half times as long as wide, consisting of three nearly equal transverse segments. Each segment below bears a pair of very small and delicate legs. The coxæ are all greatly swollen and globose, those of each side contiguous with one another and the pairs only moderately separated along the median line. Each coxa is hollowed out below and the trochanter sunk within it. Femora slender, enlarged somewhat at the base, bearing a spine apically. Tibiæ slender, of equal width, the hind ones with a preapical spine. Tarsi greatly reduced, those of the four anterior legs scarcely distinguishable from the tips of the tibiæ, furnished with a pulvilliform appendage; the posterior pair elongated, with a styliform appendage. Abdomen consisting of nine short, transverse segments and an elongated tenth segment which encloses the extrusible tip of the abdomen (11th segment?). The dorsal sclerites reach far down on the sides, as do also those of the thorax, making the underside of the body somewhat concave. Tip bearing two approximated bristles, each as long as the abdomen, in addition to a much shorter one at each lateral angle of the last segment.

The triungulins are strongly campodeiform in type, but show several remarkable adaptations in the shape of the legs. Aside from these peculiarities they are very similar to Meloid triungulins.

There are several differences to be noted between them and the triungulins of *Stylops* as figured by Packard ('98, 695) and Sharp ('01, 300). Principal of these is the presence of a pair of large, strongly pigmented eyes, and the structure of the legs in which the tarsi are so much reduced. In Packard's figure the different form of the anterior and posterior tarsi are shown somewhat as I have observed them in *Xenos*.

Of the three species of *Polistes* which are especially abundant in Texas, only two seem to be at all generally attacked by *Xenos*. These are *Polistes annularis* and *P. rubiginosus*. From the former both *Xenos pallidus* and *X. nigrescens* were bred in considerable numbers, and from the latter only *X. nigrescens*, and that in smaller numbers. The fewer *Xenos* obtained from the specimens of *rubiginosus* is due both to the smaller percentage of individuals infested and usually to the occurrence of only one parasite in each wasp. In *annularis* there were on an average from three to four *Xenos* in each parasitized wasp, and in one case ten fully

developed male pupæ. Although hundreds of specimens of *Polistes texanus* were examined they showed no parasites at any time during the season.

The following tabular arrangement has been prepared to show some of the more important relations betwen the *Polistes* and the parasites in two nests of *annularis*.

First nest of *Polistes annularis;* 86 female wasps, 44 of them parasitized by *Xenos nigrescens*. An examination of 36 of these revealed parasites as follows:

Wasp No.	Male *Xenos.*	Female *Xenos.*	Wasp No.	Male *Xenos.*	Female *Xenos.*	Wasp No.	Male *Xenos.*	Female *Xenos.*	Wasp No.	Male *Xenos.*	Female *Xenos.*
1	1	1	10	3	0	19	3	0	28	1	0
2	0	1	11	1	0	20	2	0	29	1	0
3	2	1	12	3	0	21	7	0	30	4	0
4	1	0	13	6	0	22	6	0	31	4	0
5	1	0	14	3	0	23	2	0	32	1	0
6	1	0	15	5	0	24	1	0	33	4	0
7	1	0	16	4	0	25	3	0	34	2	0
8	4	0	17	2	0	26	1	0	35	1	0
9	4	0	18	1	0	27	3	0	36	3	0

In the total of 36 wasps examined there were 91 male and only 3 female parasites. In two cases the females were associated with males in the same wasp. This great preponderance of males in the nest is very remarkable and may possibly be due to the season of the year (July) since the next nest to be described contained many more females and was collected much later (October 3).

Second nest of *Polistes annularis;* 42 female wasps, 36 of them parasitized by *Xeno pallidus*.

Wasp No.	Male *Xenos.*	Female *Xenos.*	Wasp No.	Male *Xenos.*	Female *Xenos.*	Wasp No.	Male *Xenos.*	Female *Xenos.*	Wasp No.	Male *Xenos.*	Female *Xenos.*
1	6^{e1}	1	10	0	2	19	0	1	28	0	2
2	6^{2e1}	1	11	0	2	20	2	larvæ	29	4	0
3	5	1	12	1^{e1}	0	21	0	1	30	4^{e1}	1
4	3	3	13	1 2	larvæ	22	1	2	31	0	1
5	10^{e1}	0	14	0	1	23	2	3	32	1^{e1}	2
6	4	2	15	2	1	24	0	2	33	6	2
7	1	2	16	1	2	25	2	1	34	0	1
8	2	0	17	1 3	larvæ	26	1	4	35	0	2
9	7	0	18	1	1	27	5^{e1}	0	36	4	1

Total males, 81. Total females, 44. Wasps with females only, 10. Wasps with males only, 8. Wasps with both males and females, 17. Wasps with larvæ only, 1.

[1] *e* refers to the number of males which had emerged when the wasp was captured.

A study of the conditions in this nest bring to light a number of interesting points. It is seen that seventeen, or almost fifty per cent. of the wasps contained both male and female parasites, while about an equal number contained parasites of only one sex. In these latter the number infested by males and females was about equal. A single wasp contained only larvæ, while several bore larvæ in addition to imagines. The presence of larvæ in full-grown wasps is no doubt due to a failure to keep pace in development with the growth of the wasps.

From the large number bearing parasites of both sexes, in seems probable that at times the sex of the parasites is in no way influenced by the host, or rather, that the sex of the specimens to mature in a single wasp from the large number of *Xenos* larvæ usually present is not always the same as I had previously supposed from former observations ('03, 246).

A second point of interest is the considerable number of wasps, seven in all, from which males had emerged before capture. From previous observations upon wasps in captivity ('03) I was led to believe that the hosts died very soon after the emergence of male *Xenos* from their bodies.[1] Such did not appear to be the case here, for one wasp which was actively feeding upon the nectary of a cotton square late in the afternoon (the males almost always leave the pupa case early in the morning), proved on later examination to bear ten empty male pupa cases between the segments of the abdomen. In some of the wasps included in the table it is quite possible that a number of the males may have emerged at time of capture or during the several hours confinement of the wasps in a screen box before careful examination. It has been remarked by Packard that the males are apt to emerge during any excitement or great muscular exertion of the host, for example when the wasp is caught in a net. This may to some

[1] In this connection it is interesting to note that this fact was commented upon in 1793 by Rossi in what is no doubt the first mention of *Xenos* in scientific literature. His statement given in the *Bulletin de la Société Philomathique*, Vol. 1, p. 49, is as follows: "Cet insecte habite à l'état de larve et de chrysalide dans la guêpe francaise *vespa gallica* C'est sous la quatrième anneau de l'abdomen de cette guêpe que se trouve sa chrysalide; sa présence ne nuit pas à la vie de la guêpe, et on rencontre souvent sous les anneaux de leur abdomen les chrysalides dont l'insecte est sorti, sans que les guêpes paroissent incommodées."

extent account for the discrepancy between the two series of observations.

The presence of numbers of females in the wasps during October when *Polistes* are searching for hibernating quarters suggests that the parasites pass the winter in this state. With these species as is known to be the case with *Xenos peckii*, a cursory examination under the microscope showed that the masses of eggs in several females were in a very early stage of development. From this there seems no reason to doubt that the gravid females hibernate in this state, and that the later embryonic development is passed during the early part of the following spring. It would appear very doubtful that any males hibernate. The fact that many had emerged and that those still remaining in the pupal envelopes had already acquired their adult color by October first shows almost conclusively that all would emerge before winter. Spring observations also support this idea for no males were seen in over-wintered wasps. Neither were any wasps containing empty male pupal cases seen in the spring. During the winter a large proportion of the *Polistes* die, and no doubt the ones from which males had emerged would succumb first. In the nest in question, then, only ten of the parasitized wasps could be expected to survive the winter. That the majority of these die also is shown by the scarcity of parasitized wasps in the spring.

From these facts it is evident that no males survive the winter and probable also that no wasps which have contained males survive. This necessitates the death of a large proportion of the female *Xenos* since it has been noted (*ante*, p. 292) that of 44 females only 14 were in wasps that did not contain males.

On account of the difference of opinion as to the way in which the wasps treat the emerging male parasites, a close watch was made on several occasions, but at no time could it be observed that the wasps took any notice at all of the fluttering male *Xenos*.

Quite recently Pierce ('04) has added to our list a new species of Stylopidæ described by him as *Xenos pulvinipes*. An examination of his figures and description convince me that this form is generically distinct from *Xenos* for several important reasons. According to the description the female possesses distinct eyes, a character at once distinguishing it from *Xenos*

and so far as I am aware from all other Stylopid females. It has also segmental spiracles which are absent in the other forms, and the males have very peculiarly modified tarsi.

Following is the description of the female of *Xenos pallidus*:

XENOS PALLIDUS Brues ('03).

Female. Length 8–12 mm. Distinctly more slender than *X. peckii* or *X. nigrescens*. Head black, except on the anterior third, the lines between the colors straight, transverse. Head in outline more elongate than in the other two species and less bowed on the sides, widest quite near the posterior angles (see figure 2). Thoracic integument very dark, wrinkled as usual, its posterior margin gradually slanting backwards on each side toward the median line. Dorsal stripe very distinct, always extending over seven segments as shown by its constrictions, distinctly marked posteriorly and not fading out indefinitely. Openings to the oviducts distinct, four in number, one on each of the four anterior abdominal segments near the posterior margin. Abdomen more or less distinctly constricted just before its tip.

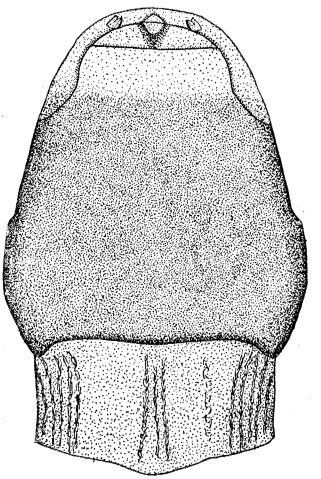

FIG. 2. Exposed portion of adult female of *Xenos pallidus* Brues.

Described from over 90 specimens found associated with the males of the species in the bodies of *Polistes annularis*.

In conclusion, I wish to thank Mr. F. C. Bishopp who collected a considerable portion of the stylopized *Polistes* considered in the foregoing notes.

BIBLIOGRAPHY.

Packard, A. S.

'98. A text book of Entomology, MacMillan Co., 1898.

Brues, C. T.

'03. A contribution to our Knowledge of the Stylopidæ, Zool. Jahrb. Abth. f. Anat., Bd. 18, Heft 2, June, 1903.

Pierce, W. D.

'04. Some Hypermetamorphic Beetles and their Hymenopterous Hosts, Univ. Studies, Univ. of Nebraska, Vol. IV., No. 2, April, 1904.

Sharp, D.

'01. The Cambridge Natural History, Insects, Vol. 2, Macmillan Company, 1901.